WIRB Final Project Report

Project Name: **East Okoboji Beach Drainage LID Retrofit Project**

Project Number: 8006-003

Soil and Water Conservation District: Dickinson

Reporting Period: 2-1-2009 – 2-1-2012

Date Report Prepared: 12-29-11

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SWCD Chairperson's Signature:

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I. Financial Accountability

WIRB Funding for East Okoboji Beach Project

All of the WIRB funds that were requested in the original grant will be used in full for the project. See Table 1 Watershed Improvement Funds for a breakdown of the WIRB contributions. Please note that the amounts listed for total funds expended by WIRB are the reflection after the final report is approved and the remaining funds will be released.

Table 1. Watershed Improvement Funds

GRANT AGREEMENT BUDGET LINE ITEM	TOTAL FUNDS APPROVED ($)	TOTAL FUNDS APPROVED-AMENDED ($)	TOTAL FUNDS EXPENDED ($)	AVAILABLE FUNDS ($)
Salary/Benefits	36,000	36,000	36,000	0
Low Impact Development Practices	350,000	350,000	350,000	0
Totals	386,000	386,000	386,000	0
Difference				0

Noted Differences in Matching Project Funds

While most of the actual dollars came out more expensive than the original estimate, the actual funds that came from Dickinson County to pay for the engineering and construction costs of the new roads were over $400,000 lower that the estimated costs. This was a result of the final costs for the survey and construction costs for the roads came in lower that what was estimated. The cash contributions from the DNR and the amount requested for a SRF loan were slightly higher than estimated, which can be explained by minor details that either came up during construction or construction costs varied slightly than what was thought.

With the in-kind contributions only a few of the project partners contributed more than they estimated. The higher costs can be contributed to supplies or materials that the partners agreed to provide for the project were not enough to cover the project and more time or items were needed.

Overall the actual cost for the project came around $350,000 lower than the original estimate, with much praise by all of the contributing partners. See Table 2 Total Project Funding for a complete breakdown of funding for the project.

Table 2. Total Project Funding

FUNDING SOURCE	CASH		IN-KIND CONTRIBUTIONS		TOTAL	
	Approved Application Budget ($)	Actual ($)	Approved Application Budget ($)	Actual ($)	Approved Application Budget ($)	Actual ($)
Dickinson County	3,157,100	2,726,511.30	0	0	3,157,100	2,726,511.30
SRF Loans	922,340.92	977,958.24	0	0	922,340.92	977,958.24
WIRB	350,000	350,000	0	0	350,000	350,000
Water Quality Commission	66,800	66,800	0	0	66,800	66,800
DNR	165,352.89	175,678.11	0	0	165,352.89	175,678.11
EOB Homeowners Association	10,000	10,000	4,000	5,000	4,000	5,000
Dickinson SWCD	0	0	8,000	10,000	8,000	10,000
NRCS	0	0	5,000	5,000	5,000	5,000
EOLIC	0	0	3,000	3,000	3,000	3,000
Clean Water Alliance	0	0	4,141	5,000	4,141	5,000
Totals	4,671,593.81	4,306,947.65	24,141	28,000	4,685,734.81	4,324,947.65

Watershed Improvement Fund contribution: Approved application budget: 8%
Actual 8%

II. Environmental Accountability

Water Sampling Data Interpretation

Throughout the course of the project storm water monitoring was performed using first flush samplers. These samplers are installed at ground level and are designed to store the first 5 liters of storm water from a rainfall event. Once the samplers begin to fill up rubber stops raise up with the water level and plug the intakes to prevent any contamination from the rest of the rainfall event. With us being able to catch the first flush of water that flows off from the surface, it will show us the concentrations of pollutants that are on the surface without giving it a chance to become diluted. See Table 3. Water Sampling Data for the results from the water sampling done in conjunction with the EOB project.

Table 3. Water Sampling Data

	AH	EOB	AH	EOB	AH	EOB	AH	EOB
Date	TSS	TSS	Nitrite	Nitrite	Nitrate	Nitrate	Phosphorus	Phosphorus
13-Jun-09	850	740						
8-Jul-09	760	1600						
15-Jul-09	270	7200						
25-Aug-09	60	16000						
13-Apr-10	13000	46000						
7-May-10	320	4200	0.04	0.02	1.3	0.8	1.2	8.7
25-May-10	82	960	< 0.02	2	1.9	0.6	1.6	2.4
8-Jun-10	240	1000	0.04	0.07	0.9	1	1.7	1.7
22-Jul-10	330	3300	< 0.02	0.06	< 0.2	2.2	0.48	2.5
24-Aug-10	130	650	0.08	0.02	2.2	0.8	0.43	1.1
9-Sep-10	150	140	<0.02	0.04	0.5	1.3	0.58	0.48
16-Sep-10	48	130	<0.02	0.04	0.2	0.6	0.33	0.18
22-Sep-10	260	610	<0.02	<0.02	1	1.5	0.66	0.66
31-Aug-10	150	160	0.04	0.06	2.1	1.5	0.76	0.54
24-Oct-10	3000	2500	0.07	0.11	0.5	1.4	3.2	2.1
11-May-11	230	120	0.16	0.16	4.2	3.3	1.1	0.49
20-May-11	5200	2300	<0.02	<0.02	0.3	1.5	5.5	1.9
10-Jun-11	1000	650	0.02	<0.02	0.5	0.7	1.38	0.92
29-Aug-11	58	38	0.04	0.03	0.4	0.6	0.3	0.27
16-Sep-11	44	69	0.08	0.06	2.7	1.3	1.15	1.18
10-Oct-11	220	120	0.08	0.09	3.2	1	3.3	1.1

To set up the water monitoring plan we installed two sampling sites. The first station was set up in the East Okoboji Beach (EOB) subdivision in a paved drainage ditch that received runoff from the south end of the subdivision. Along with the first flush sampler we installed a transducer to measure flow that occurred during each rain event. The second station we set up was in the Arthur Heights (AH) subdivision that is directly south of EOB. We chose AH to use it as a control for our monitoring since the roads are already paved and lack any conservation practices in the subdivision, and will remain the same throughout the project. By using a three year timetable for water sampling, we are able to show before construction, during construction, and after construction pollutant levels when the conservation practices are installed.

The first season of sampling was done during the summer of 2009. We took these samples to show the high levels of sediments flowing directly into East Lake Okoboji without any conservation practices present. As you look at the data almost each time EOB is many times higher than AH in total suspended solids. When we took samples we observed that most of the suspended solids in the EOB sample were sediment running off from the gravel roads, while most of the suspended solids in AH were gravel and sand.

The second season of sampling was taken April through October in 2010 during all of the construction phases in EOB. We started sampling for nutrients along with the suspended solids so we could get an idea how many nutrients are attached to the suspended solids that are flowing into the lake. More of the same trends were prevalent in 2010 as they were in 2009. In almost all of the results EOB is again higher than AH in most of the categories.

The final season we sampled was May through October of 2011. With these results we are looking at the effects that paved roads and installed conservation practices will have in EOB. These results are almost a reversal from what we have has the previous two years. EOB is less than AH in most of the categories.

Data Conclusions

There have been many positive changes that the project has had on the quality of storm water runoff from EOB. When looking at the data it has shown that EOB was higher in almost all categories tested for the first two years, but since the installation of conservation practices and the paving of all of the roads in EOB, the results have shown that EOB is lower in most of the categories than AH is. With this data we can prove the benefits LID practices have on filtering storm water and can use this data for validation for the need of future projects that have LID components in them.

There are also benefits that have occurred from the project with water volume that the water sampling data can’t show. When we started to take samples in 2009, the samplers at EOB and AH would fill up with anything over a .1 inch rain. When there would be a substantial rain of an inch or more it would trigger the flash raging river of sediment filled water flowing from EOB (shown in Photo 1). The pattern of runoff volume stayed pretty consistent through the 2010 sampling season. The major change came once the roads were paved and the LID practices were installed for the 2011 sampling season. While the AH sampler has always filled up with anything over a .1 inch rain, it now takes at least a .3-.4 inch rain to fill the EOB sampler. Now when we get the substantial rains of over an inch, we now get a slow trickle (see photo 2) of mostly clear water that flows from the outlet for days or sometimes up to a week after the rainfall event. The function of the LID practices is to slowly infiltrate and filter water, with any excess draining into the tile line at the bottom of the practice. This explains why there is the slow discharge of water we are seeing in EOB.

While the data we have collected has proven the benefits of installing LID practices, some additional water sampling might be conducted. Depending on funding from additional partners in the project, we might continue to take water samples in the future to show how well the LID practices will reduce sediments and nutrients as the practices age.

Photo 1 before

Photo 2 after

LID Practices Installed

Each of the LID practices installed was strategically placed in spots where there would be higher runoff rates to capture as much stormwater as possible. Each LID practice was sized to accommodate the amount of stormwater runoff that would be flowing to that area while not over sizing them to drive up the cost of the project. Below is a breakdown of each practice installed along with a description of each practice.

Enhanced Swales – There was a total of 122 enhanced swales installed throughout the EOB subdivision. These practices were targeted to be installed in the ditches along the roads where there will be a high volume of storm water flowing through them. In each of these enhanced swales there are rock check dams that are put before and after the swale. The rock check dam slows water as it flows through the swales and allow more water to infiltrate into the cell. These cells were planted with a variety of native sedges in the cells that had more shade, while native grasses were planted in the cells that receive more sunlight. These mixes of plants are allowed to grow to full length to slow flowing water and to supplement the infiltration of water.

Enhanced Swales with Plants – Along with the 122 enhanced swales, there were three swales that were engineered to the same specifications as the enhanced swales, but plugged with native flowering plants in them. These swales with the plants were placed on flat surface right before the intake in the ditch. This allows most of the water that is flowing through the ditch to be absorbed in the normal swales, so there is only low water volume flowing thought the swales with plants to prevent the plants from being washed out. The flowering plants in the cells also add to the beauty factor with the cells. It makes them more appealing to the average person that drives or walks by them on the street.

Bio-retention cell – There was one bio-retention cell installed in EOB. The cell was placed at the outlet of a culvert that collects storm water runoff from streets and houses in the subdivision. Before the project this culvert outlet drained directly into the lake without anything to catch or slow the water. Now this cell catches the first 1.25 inches of storm water that flows out of the culvert and allows it to infiltrate into the ground. This cell is also placed next to the public access boat ramp in EOB that receives heavy boat traffic during the summer, where it is visible to everyone who uses it. This cell was seeded to a native grass mix. This mixture slows the water while it flows through the cell while it absorbs into the ground.

Rain Gardens – There are a total of 13 rain gardens installed in EOB. These practices are located in spots along the road ditch where there is lower water volume flowing through the ditch and where it can be stopped and prevented from flowing into the lake like dead end streets. The low volume flows allow the water to become suspended in the rain garden so it can infiltrate into the ground. The rain gardens are plugged with native plants that are tolerant of wet conditions and act as an extra filtration since they will absorb water and nutrients as the water is absorbed into the rain garden.

See Table 4 Practices and Activities below for a breakdown of all of the proposed practices vs. what was actually installed.

Table 4. Practices and Activities

PRACTICE OR ACTIVITY	UNIT	APPROVED APPLICATION GOAL	ACCOMPLISHMENTS	PERCENT COMPLETE
Bio-retention Cells	No.	1	1	100
Enhanced Swales	No.	118	122	103
Rain Gardens	No.	20	13	65
Enhanced Swales With Plants	No.	0	3	300

Project Area Maps

To illustrate the location of every LID practice that was installed with the project, see photos 3 and 4 below. Photo 3 shows the North half of the subdivision while photo 4 shows the South half of the subdivision. Each of the individual LID practices is represented by different colors. The enhanced swales are shaded blue, the enhanced swales with plants are shaded red, rain gardens are shaded yellow, and the bio-retention cell is shaded green.

Photo 3. EOB North

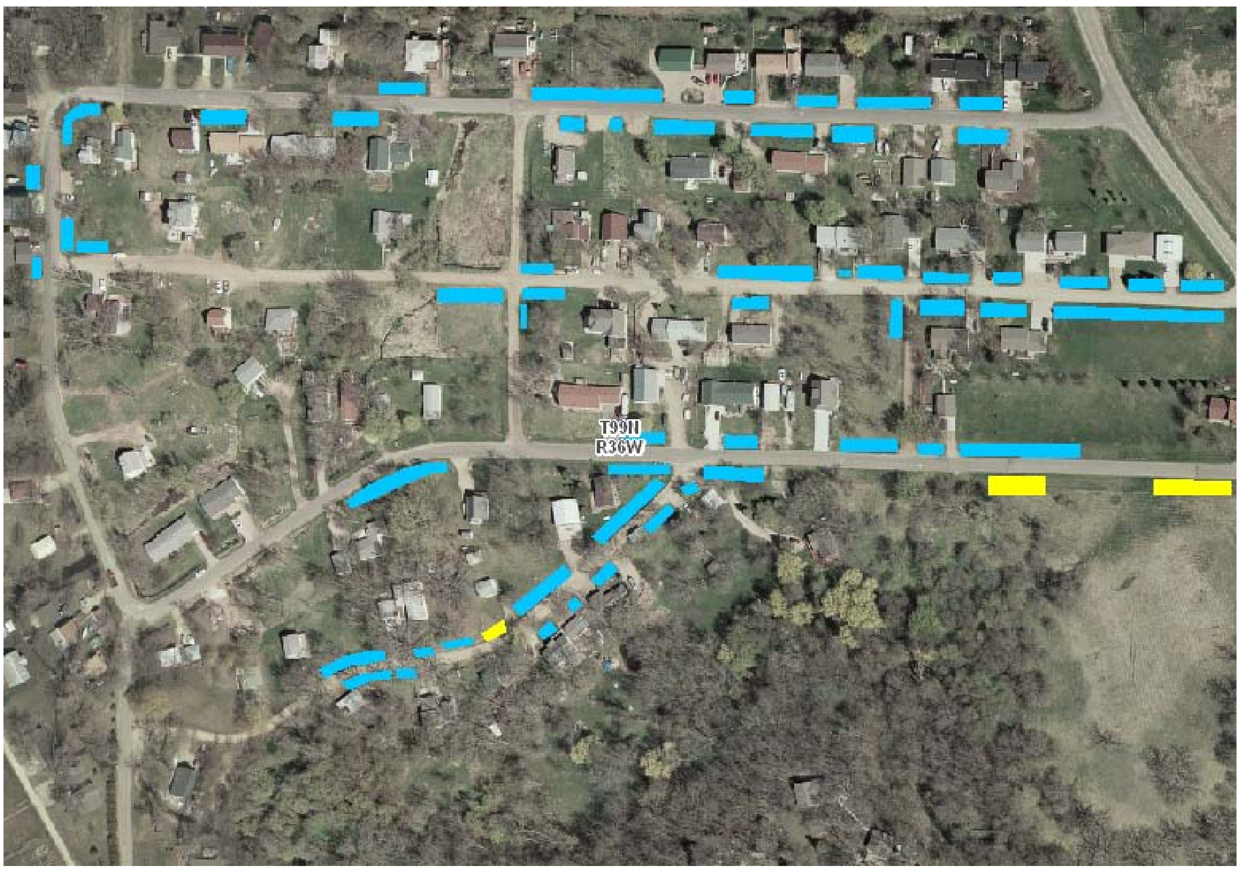


Photo 4 EOB South

Other Practices Installed

Along with the LID practices that were installed, there was the main construction project that converted all of the gravel roads into paved streets and modified the drainage system to better accommodate for rainfall events and to help direct more stormwater into LID practices. The paved streets alone will benefit the quality of the stormwater runoff compared to the old gravel streets. While there will be more sand and salts that will accumulate on the paved roads to melt ice, which will be caught and held in the LID practices, the amount of suspended solids in the stormwater runoff has dropped dramatically since the road construction as proven by our water sampling.

See photos 5-6 and 7-8 below that illustrate the difference the project has had. Before the paved roads water was directed into ditches, but without proper cover and the instillation of LID practices gullies were allowed to form that would have kept increasing in size without the project. Once the water, already full with suspended solids and nutrients, flowed off the gravel roads, it was then combined with the sediments from the eroding ditch to generate large amounts of pollutants in it. Now when the stormwater runs off it is conveyed to the ditch on a cleaner surface and filtered and infiltrated into the LID cells.

Photo 5 before

Photo 6 after

Photo 7 before

Photo 8 after

Pollutant Delivery Reductions

In general, pollutant delivery reduction is difficult to predict while using LID because there is not a proven method of pollutant prediction and reduction. Without us being able to utilize the sediment delivery calculator or RUSLE value to determine sediment load or gallons of water treated, we can use typical concentration of pollutants in stormwater numbers that have been calculated from the EPA and the Nationwide Urban Runoff Program (Table 5).

Table 5. Average Concentration of Pollutants in a Gallon of Stormwater

TYPE OF POLLUTANT	POUNDS PER GALLON
Suspended Solids	.000801
Phosphorus	.000001
Total Kjeldahl Nitrogen	.000007

Using the Iowa statewide average of 32 inches of precipitation a year, and that an inch of water sitting on an acre of land has a total of 27,152 gallons, we can put together a simple equation to calculate how many gallons of stormwater flow from the watershed and how many pounds of nutrients each gallon is carrying that are treated by the LID practices each year (Table 6). We have to take 90% of the average total of 32 inches of precipitation per year (28.8 inches) since the LID practices are only built to capture every 1.25 inch and smaller rain, which is 90% of the rain fall events that occur in Northwest Iowa.

Table 6. Gallons of Stormwater and Pounds of Nutrients Treated Per Year

Site	Total Watershed Size (Acres)	Water Volume (Gallons)	Suspended Solids (Pounds)	Total Kjeldahl Nitrogen (Pounds)	Phosphorus (Pounds)
East Okoboji Beach Subdivision	76	66,033,664	90,241	754	161

III. Program Accountability

Project Challenges

Throughout the project there were a few small challenges that arose but were easily solved. The main problem we had from the SWCD side was with the water monitoring. For the first year taking water samples was easy since when it rained there was just the flash flow of runoff that ended quickly after the rainfall, so we were able to go out right away and collect the sample. Now with the LID practices installed there will be the slow trickle of water for days that runs directly over the water sampler. When we go out to collect a sample now we have to create a makeshift diversion device that directs the water around the sampler for a brief period of time that allows us to take the lid off the sampler and remove the jug with the first flush sample in it preventing the new water from contaminating the sample.

Besides a few small issues that would be expected to happen with any large construction project the main issue from the contractor's side was making sure the timing of when the respected people were supposed to perform their part was started and finished on time. Since this project had so many partners and groups involved in the planning and construction of the roads and LID practices there were times when there were delays in the original timetable of completion of the project, but in the end issues were worked out or worked around and the project finished a success.

From the start of the project one problem that came up a few times was swaying EOB homeowner's opinion and perception of LID practices. There were concerns raised by some of the impact this would have to their property or the appearance they would have once they were installed. There were two different education sessions that were held during the project that everyone that lived in EOB was invited to that showed the public everything from how these practices worked to water quality benefits to what they would look like once they were installed. We also informed the public on proper care of these LID practices and what they could and not do with them. Now that we have had a full year of these practices installed mostly everyone within EOB is in full support of the project now that they see how well they function and are able to see the benefits of them first hand.

Lessons Learned

One of the lessons that was learned by everyone associated with the project was the need for monthly meetings throughout the project that one person from each group involved in the project attended. These meetings were attended by representatives from Dickinson County, Iowa DNR, Dickinson SWCD, East Okoboji Beach Homeowners Association, each of the contractors involved in the construction phases, and from the utility companies involved in the project. These meetings consisted of everyone giving a report of what they have completed in the last month and what they will be doing in the next month. This allowed everyone to get on the same page and let and concerns or problems be addressed at once by everyone. Without these meetings the project would have had issues of lack of communication between everyone to ensure as the project progressed everyone was ready to do their part.

Another lesson learned by everyone involved is the patience and work that is required to complete a project of this magnitude. With such a big project spread across multiple agencies, groups, and contractors it was a learning experience for everyone to see how business is run differently from one group to another and what doesn’t work and what will work in the future. This project’s successes have shown that is it possible for a project of this size to be successful and will be applied to similar projects in the future. There are at least two other projects similar in size that deal with incorporating LID practices into new or existing subdivisions that have been inspired from the EOB project. As these projects become completed we hope to keep expanding this idea to multiple areas within the Iowa Great Lakes watershed to promote LID as a well know and heavily used tool to promote water quality in the lakes region.

Limitations for Future Projects

The main limitation that could be a factor for future projects that have either a majority or the whole project is urban conservation based is selling LID for what it is. Luckily we have been implementing urban conservation practices since 2005 in the IGL watershed, so there was a large public awareness about it before the project started. Since our whole community and economy is based around the IGL system, it makes it easier to sell unique and different conservation projects because the public is aware of water quality issues and recognize the IGL as a resource worth protecting. If you were to try to start a project of this type and size in a community that does not have a major water body in or around it, it could be more difficult to show the public the benefits of these practices without them not being able to see immediate effects. It took a couple of years before public officials, home owners, and land owners in the IGL watershed were on board to wide spread implementation of LID, but as evidence in this project and many others like it, once the public’s perception of LID is favorable, it almost takes on a life of its own and keeps growing.

Information and Education

One of the main focuses in the project was to use the practices to inform the public about LID and its uses within urban settings. We wanted this project to be a pilot project to use the same designs and concepts for future urban developments. With a majority of the cities within the IGL Watershed having or planning on implementing stormwater mitigation rules within their city limits for new construction projects, they can follow the EOB model for designing LID practices within new developments.

LID Practice Signs

Signs were installed throughout EOB that mark each individual LID practice that are visible by either walking or driving on the road adjacent to each practice. Each of these signs is placed within the cell and is assigned a number (See photos 9 – 12 that show the types of signs). These signs will assist the public in identifying the individual practices and show the placement of each of them.

Photo 9 Enhanced Swale Sign

Photo 10 Enhanced Swale with Plants Sign

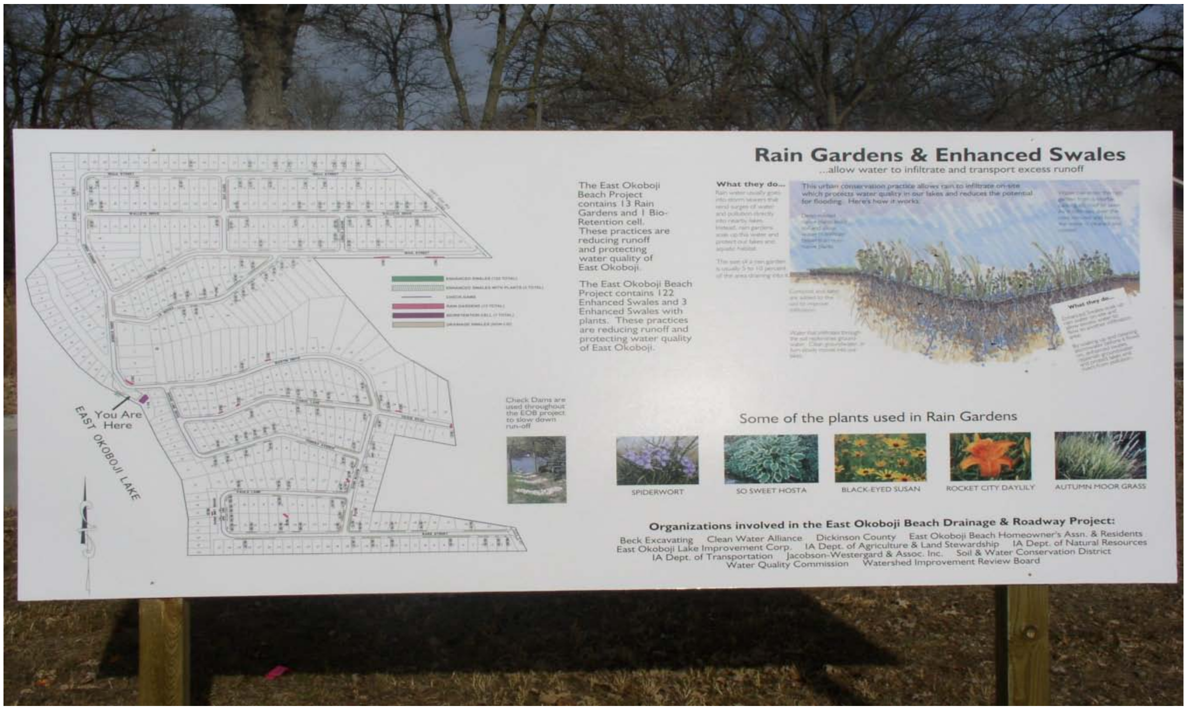
Photo 11 Bio-Retention Cell Sign

Photo 12 Rain Garden Sign

LID Key Map

There is one main sign that is installed near the EOB boat ramp that acts as the map and key for the location of all of the LID practices in EOB (See photo 13). The decision was made to install the sign at the boat ramp since it is centrally located in EOB and it will be the spot that will receive the most pedestrian traffic. From this sign people will have the location for every LID practice and be able to identify the type of practice that is installed. Along with the key the sign also has all of the partners associated with and involved in the project listed at the bottom.

Photo 13 Map and Key Sign



Future Information and Education Efforts

Even though the main project is complete and implemented, we have events scheduled in the future that will continue to promote the EOB project. In the spring of 2012 there will be the official ribbon cutting ceremony to celebrate the completion of the EOB project. There will be a press release sent out in advance to invite the public and interested citizens to join us for the event. All of the partners involved in the project will be invited to showcase their work or to answer questions from the public about the project. The event will also feature a walk-through to show everyone they different types of LID practices and how they function to promote water quality in the IGL.

In March of 2012 at the Iowa Water Conference in Ames, IA Steve Anderson, Northwest Iowa Urban Conservationist, will give a presentation about the EOB project. The presentation will cover many details about the project from the background and development stages up to costs and impacts the project is having on water quality and impacts to future developments within the IGL watershed. Since this conference has hundreds of attendees from throughout the Midwest, it has the potential to be seen my many different people.